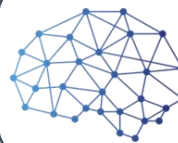
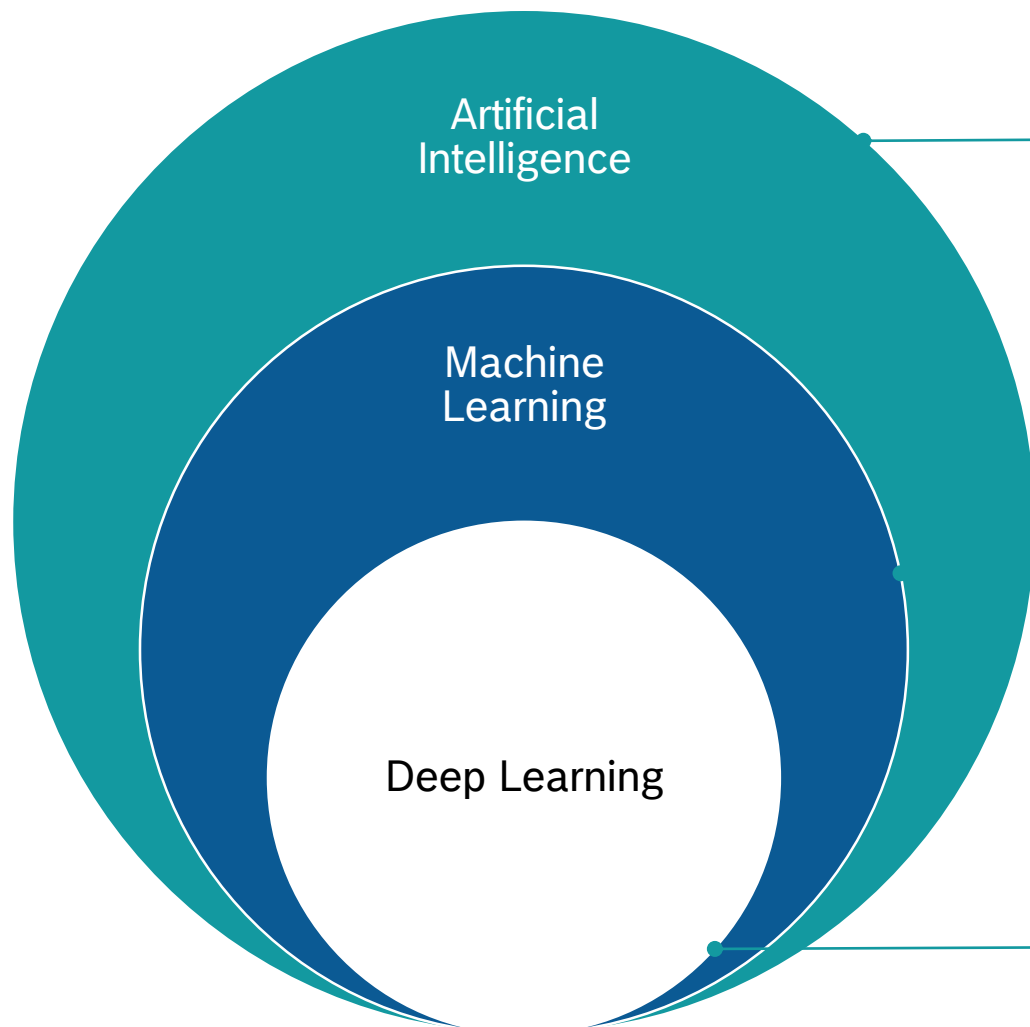


**ROBERT BOSCH ENGINEERING
AND BUSINESS SOLUTIONS**

ARTIFICIAL INTELLIGENCE

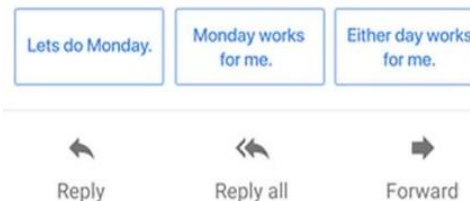
What is Artificial Intelligence(AI)?



Artificial Intelligence

Ability of machines to perform functions similar to that of human mind

Ex: ML



Machine Learning

Ability of computer systems to improve their performance without need to follow explicitly programmed instructions

Ex: DL

Google's AlphaGo AI beats the world's best human Go player

Darrell Etherington @etherington / May 23, 2017



Deep Learning

Sets up basic parameters about the data and trains the computer to learn on its own by recognizing patterns using multiple layers of processing

Artificial Intelligence @ Bosch

AI Topics

Data-driven Physical Modeling

CAPABILITIES

Data-based, non-parametric, dynamic, and real-time-capable regression models from system measurements.

DEPLOYMENT

Prediction models used for system optimization, diagnosis and controller design.

Explainable Deep Learning

CAPABILITIES

Apply DL algorithms with a guaranteed reliability to meet functional safety requirements.

DEPLOYMENT

Sensor data and environmental uncertainty can be quantified explicitly.

Large Scale Deep Learning & AI

CAPABILITIES

Novel DL algorithms for video understanding
Large scale machine learning and AI

DEPLOYMENT

Basis for scaling up AI;
video search DL models

Robust Control Learning

CAPABILITIES

Automatically calibrate and adapt controllers, ensuring performance and stability.

DEPLOYMENT

Basis for products that learn and adapt.

Environment Understanding & Decision Making

CAPABILITIES

Understand scene, object context and relationships beyond classification and act accordingly.

DEPLOYMENT

Intelligent decision making in multiple domains.

Dynamic Multi-Agent Planning

CAPABILITIES

Optimal and safe robotic behavior in an uncertain environment, where requests vary dynamically.

DEPLOYMENT

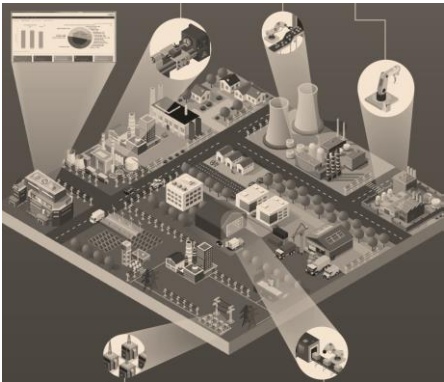
Real time planning process.

Artificial Intelligence @ Bosch

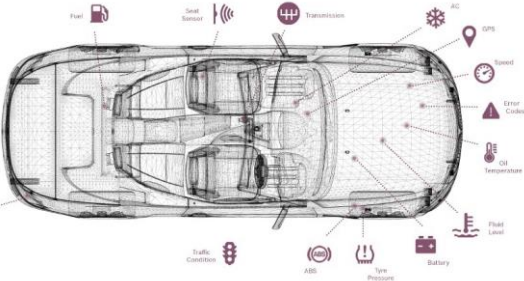
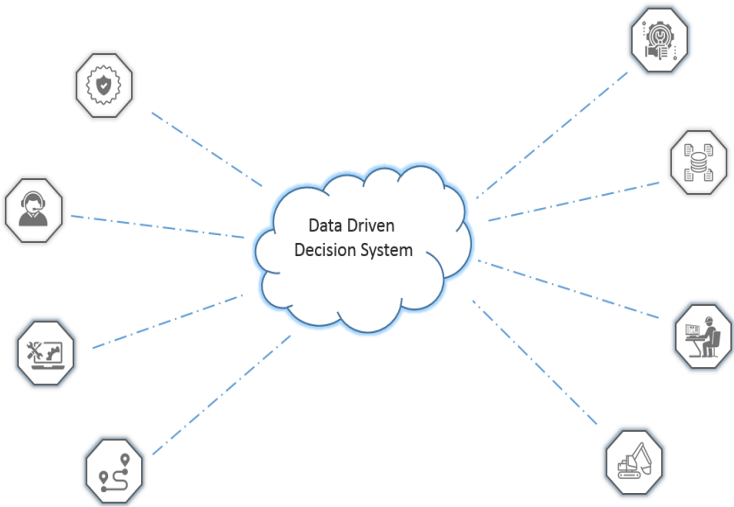
Intelligence Across Domains

RED BLOOD CELL MORPHOLOGY				
Size variation	Hemoglobin distribution	Shape variation	Inclusions	Red cell distribution
Normal	Hypochromia	Target cell	Acanthocyte	Pappenheimer bodies (siderotic granules)
Microcyte	1+	Spherocyte	Helmet cell (fragmented cell)	Cabot's ring
Macrocyte	2+	Ovalocyte	Schistocyte (fragmented cell)	Basophilic stippling (coarse)
Oval macrocyte	3+	Stomatocyte	Tear drop	Howell-Jolly
Hypochromic macrocyte	4+	Sickle cell	Blair cell	Crystal formation
	Poikilocytosis (Reticulocyte)			HbSC
				HbC

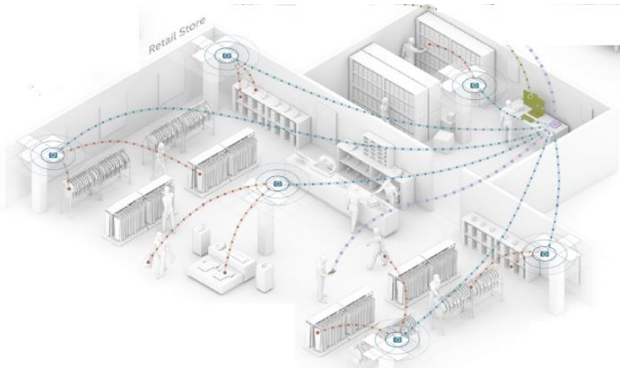
HEALTHCARE



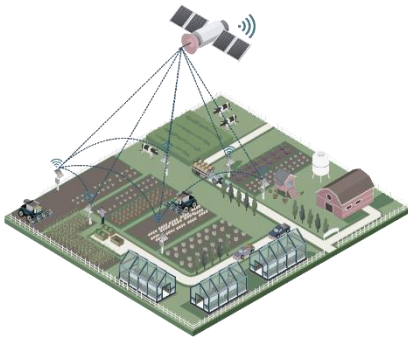
CONNECTED ASSETS
AND ENERGY



CONNECTED VEHICLES



RETAIL



AGRICULTURE

Artificial Intelligence and Digital Analytics

Business Benefits Realized

AUTOMATIC ROUTING ASSIST

Automatic fleet routing sequence for satisfying pickup and delivery orders

~10%

reduction in fuel cost per trip

15%

reduction in inventory holding costs

INVENTORY REDUCTION

Analysis of past sales, stock positions and customer demand

~10%

cost savings opportunity for an European Automotive OEM

PREDICTIVE MAINTENANCE

Predict systems / component failure to provide higher availability

WARRANTY REDUCTION

Predict field claims using Diagnostics and field

Brake index insights to driver for need based brake maintenance

SERVICES MANAGEMENT

Spare parts recommendations to resolve issues in shortest possible time

First time right Service

Reduction

in re-visits leading to increased customer satisfaction

GUIDED DIAGNOSTICS

Data driven recommendations for contextual troubleshooting sequences

OPTIMIZE

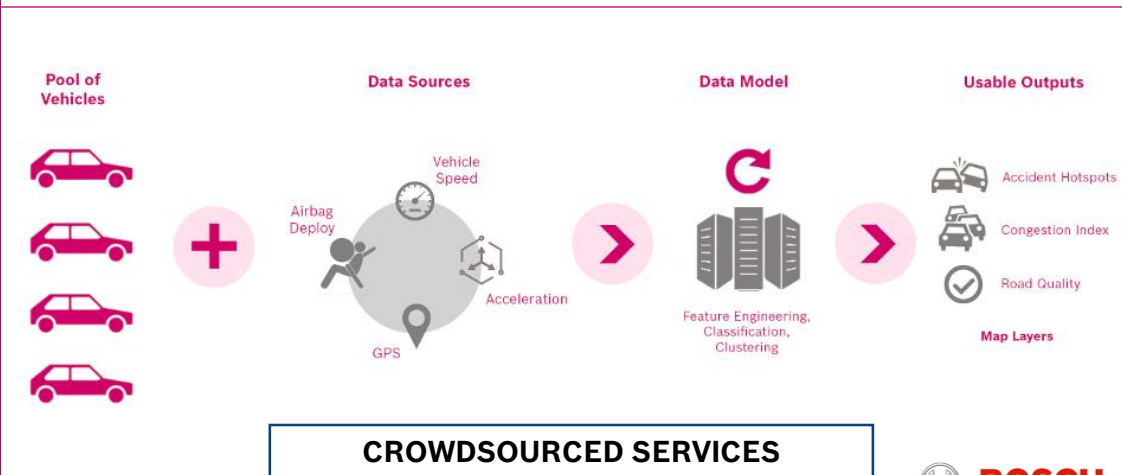
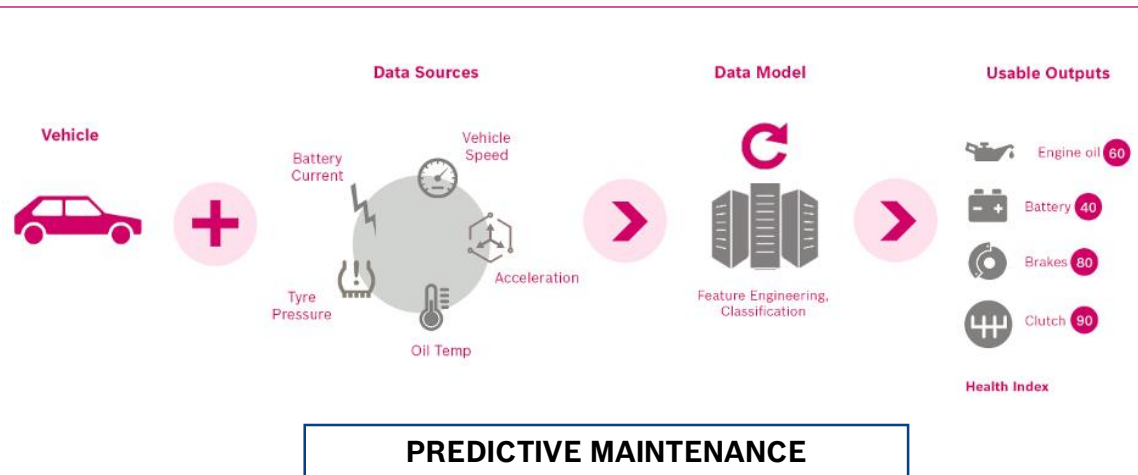
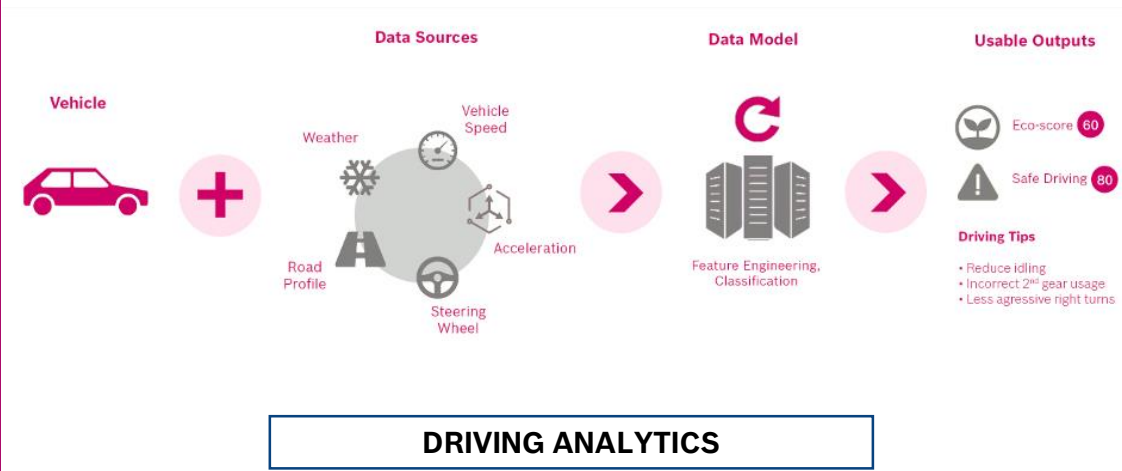
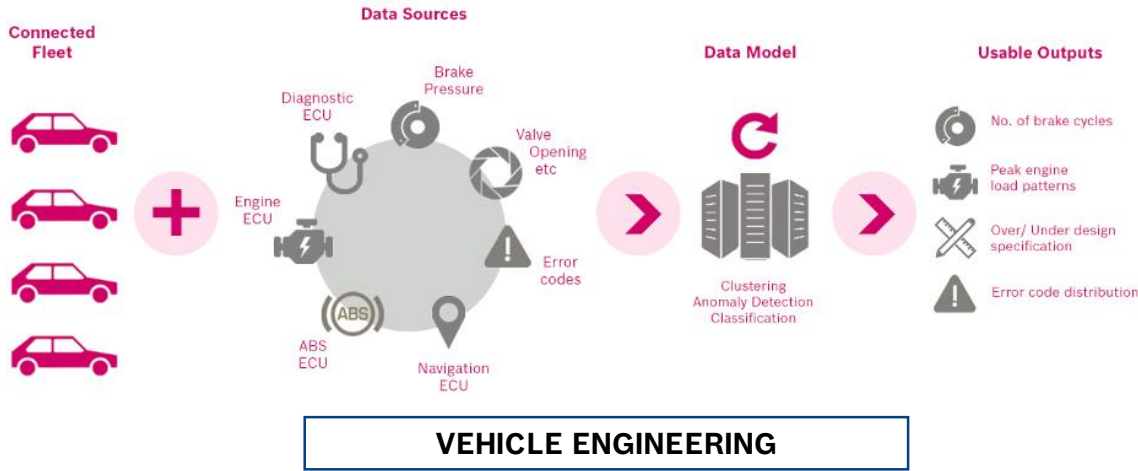
PREDICT

ACTIONS

INTELLIGENCE ...


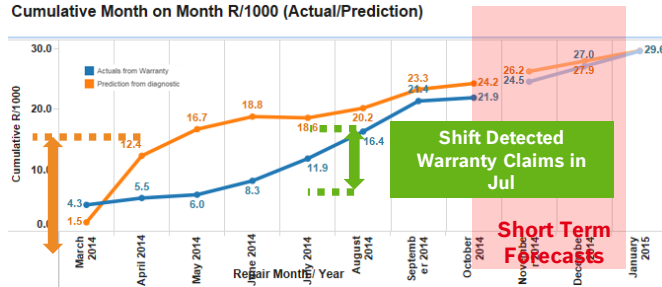



Artificial Intelligence for Connected Vehicles

Connected Vehicle Analytics



Artificial Intelligence for Field Data Analysis

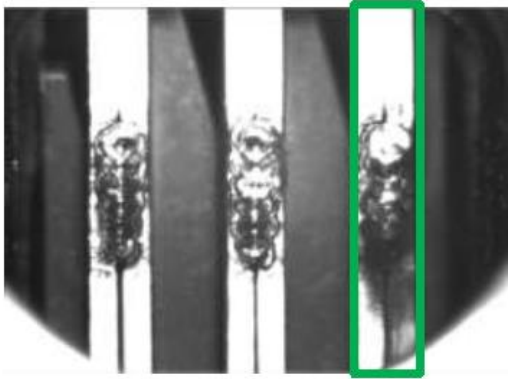
Early Warning System for Warranty Claims

Business Objective		Early warning system to predict field claims for transmission of OEM		
Data Sources & Analytics Approach	<div><div>DATA</div><div>METHODOLOGY</div><div>RESULTS</div></div>			
	<div><div>Field Diagnostics Data</div><div>Other Data Sources</div></div> <div><div><ul style="list-style-type: none">▶ 43k global VIN sessions▶ Diagnostics trouble codes▶ Data identifier▶ Module, Fault type</div><div><ul style="list-style-type: none">▶ Vehicle Diagnostic data▶ Hotline support▶ Warranty claims▶ Manufacturing data▶ Technician's comments▶ Roadside Assist</div></div>	<div><ul style="list-style-type: none">▶ Algorithmic ETL▶ Association Mining▶ Graph clustering▶ Page ranking▶ Similarity measures</div>	<div><div>Cumulative Month on Month R/1000 (Actual/Prediction)</div><p>Shift Detected Warranty Claims in Jul</p><p>Short Term Forecasts</p><p>DTC = diagnostics trouble code VIN = vehicle Identification number DID = data Identifier</p></div>	
Result		<div><ul style="list-style-type: none">▶ Development of early warning system to detect quality issues using vehicle diagnostic information▶ Identification of VINs with risk of failure</div>		
Value		<div>7% reduction in annual warranty costs and prediction of field failures at least 2 months prior to occurrence</div> <div></div>		

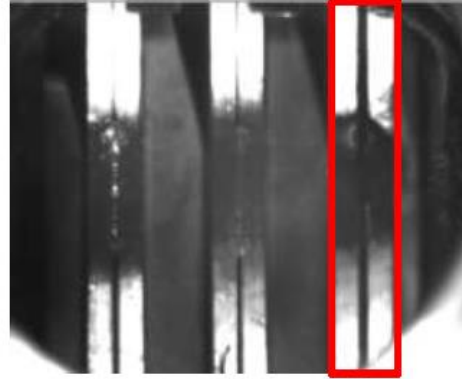
Artificial Intelligence for Manufacturing Quality Control

Image Analytics for End of Line Quality Inspection

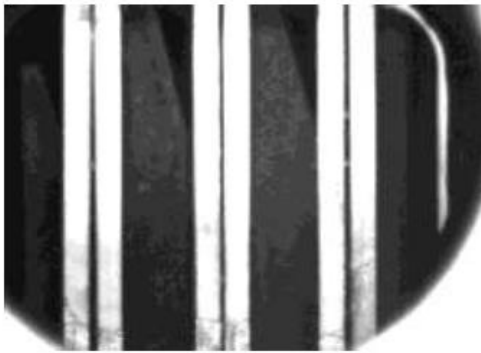
Picture of Welding Result



OK part



NOK part



NOK part



Borderline part

Scope

Identify welding failures at end of line for pin pair gap (using **deep learning** based approaches)

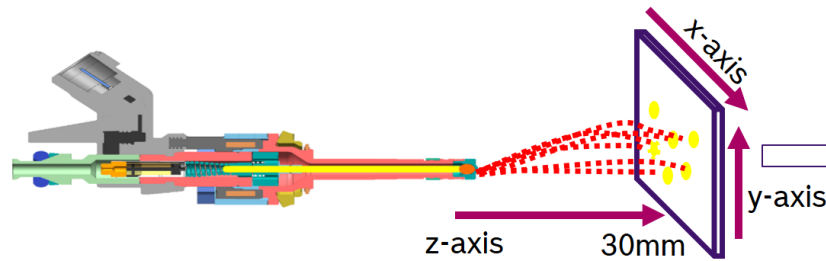
Results

- *Overall objective attained:* Detect NOK parts with 100% accuracy
- *Phase 1:* 15% OK parts classified as NOK parts
- *Phase 2:* 1% OK parts classified as NOK parts

Artificial Intelligence in Engineering

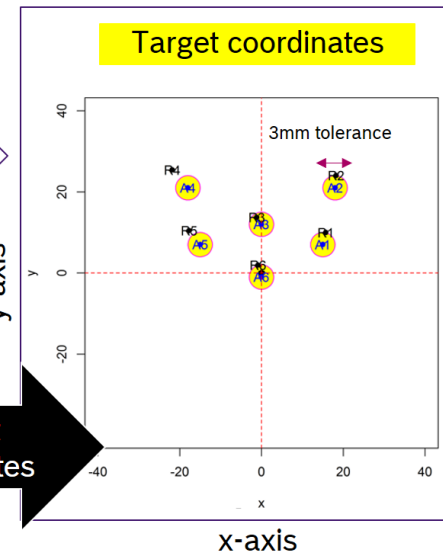
Precision Design of Injector Pumps

Error rate
reduced by
26% and
increase in
cycle time



- ▶ For each injector, the target coordinates of spray plume are defined 30mm away from the spray hole as in the figure
- ▶ Spray plume should hit the target within 3mm tolerance
- ▶ If any spray plume fails, Injector is faulty and discarded.

Result
coordinates



Artificial Intelligence in Agriculture

Drone-based image analytics: blueberry counting

Smart image analytics solution to better estimate harvest dates and volume



Situation



1800 hectares farm employs close to **12000 workers** to manually harvest the berries



Use technology to better estimate harvest **dates** and **volume** of the harvest



Life cycle of a blueberry goes through **7 different stages** and lasts **87 days**



Drone



Computer Vision



Deep Neural Network



Statistical & regression models

Real-time Data Acquisition

- Berry-cluster localization
- Berry count derivation

Stage Classification
(7 stages in Blueberry life cycle)

- Climate
- Humidity
- Environmental factors



Benefits



Complete visibility of the health of the crop



Production Volume Estimation



Precision Farming



Competitive farming

Scalable smart platform and sensor infrastructure for remote farm monitoring

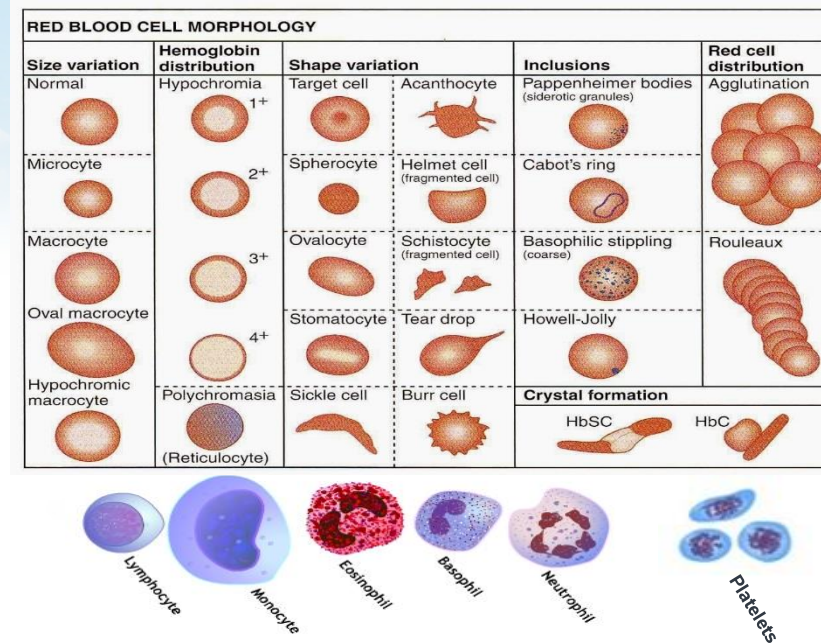
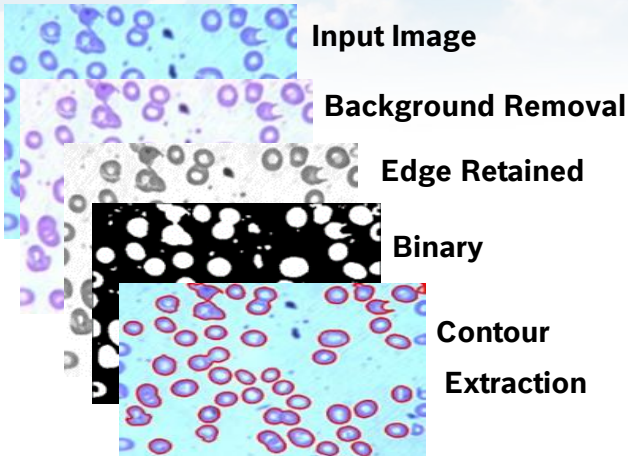


 **BOSCH**





Artificial Intelligence in Medical Sciences

Intelligent image processing, ML based classification

Advanced Image Processing



Key Benefits

-  Manage scale of users
-  Reduce the demand for experts
-  Reduce manual errors
-  Improved turn around time
-  Enable digital healthcare

How AI solves this problem?

Analysis of millions of cells are performed at sub-cellular level based on

Size analysis,
Morphological analysis,
Colour analysis,
Textural analysis,
Count analysis

where AI plays a vital role by providing standardized and reproducibility of results

Machine Learning and AI methods help in analysing millions of cell at submicron level

THANK
YOU